

# CCIS in the Knowledge Centric Age

LTC Lock Pin Chew

Hd Command Post of the Future

SAF Centre of Military Experimentation

Future Systems Directorate

Singapore Armed Forces

*concurrent position:*

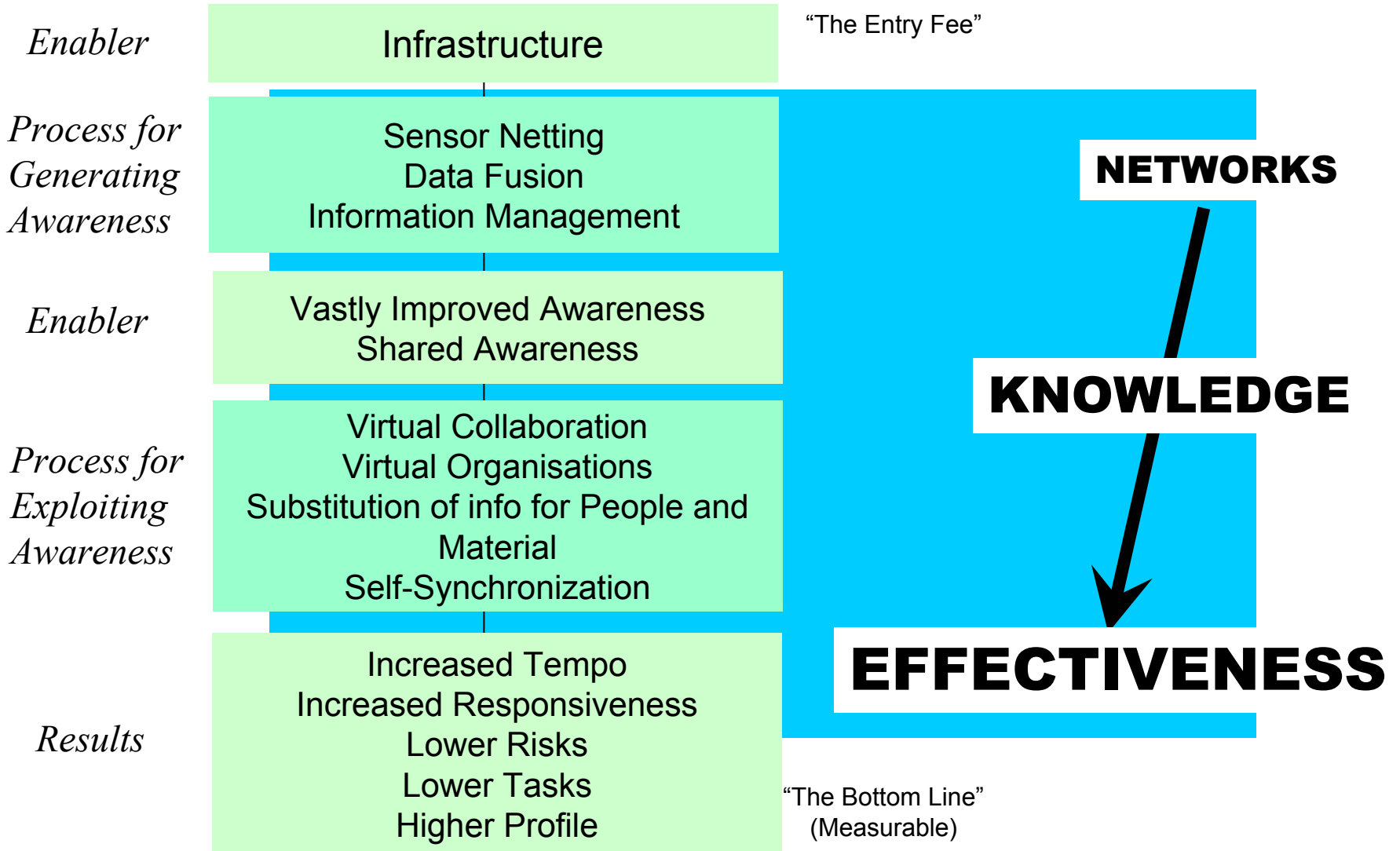
Division Manager

Integrated Knowledge Based C2 Solutions Division

C4IT Services

Defence Science and Technology Agency

# A Knowledge-Age Postulate

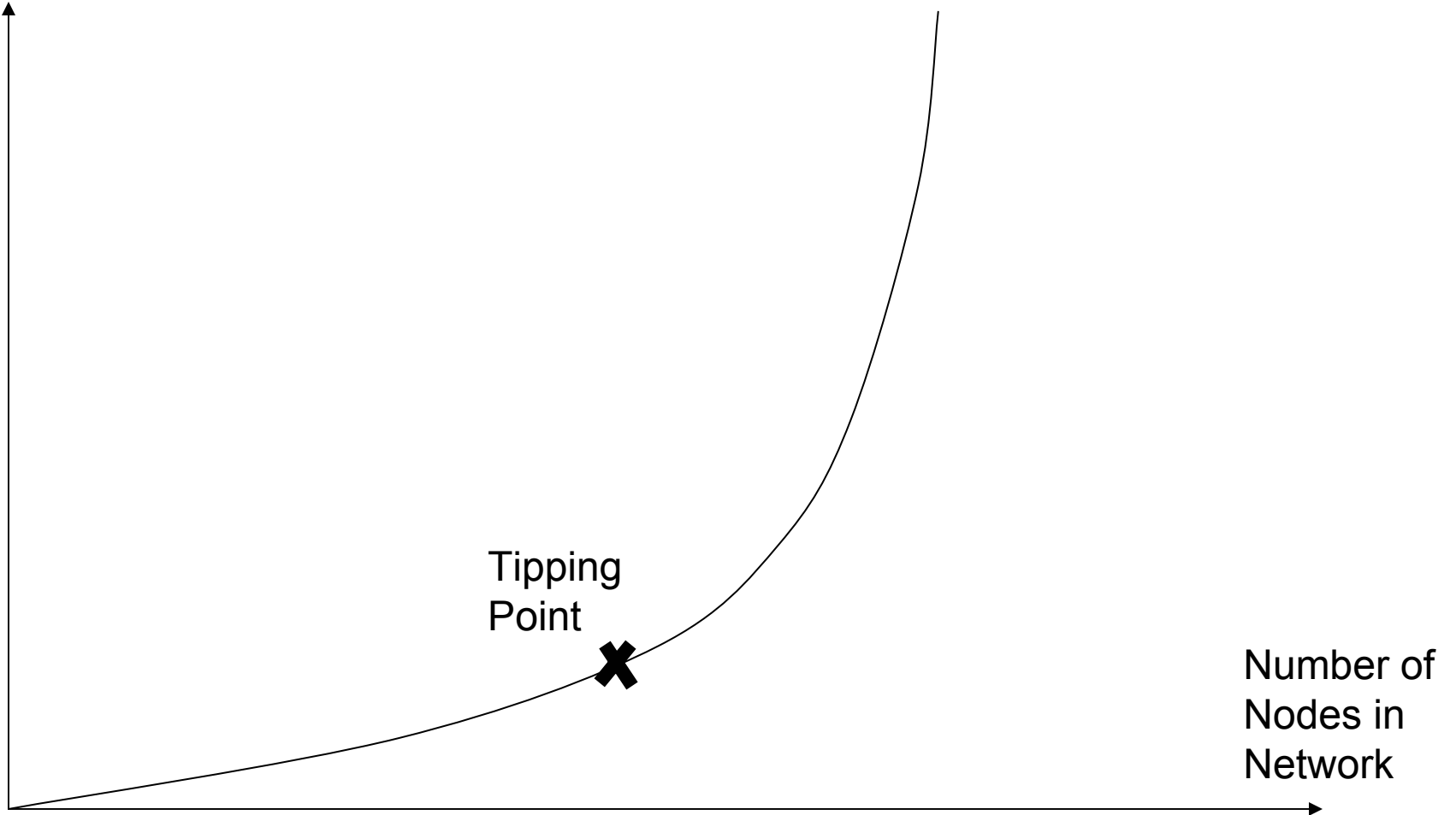


# Agenda

- Purpose of Command Control and Information Systems (CCIS)
  - Enabling Knowledge-Centric Operations.
- Towards some principles on designing CCIS
  - Fusing the Cognitive and Information Space
  - Command Control Knowledge System (CCKS)
- Architecture of CCKS
  - Solutions Architecture: Serviced-Oriented foundation Architecture, Sense-Maker, Process-Maker, Collaborator
  - The Mission Mate (an example)

# Metcalfe's Law

Value of  
network

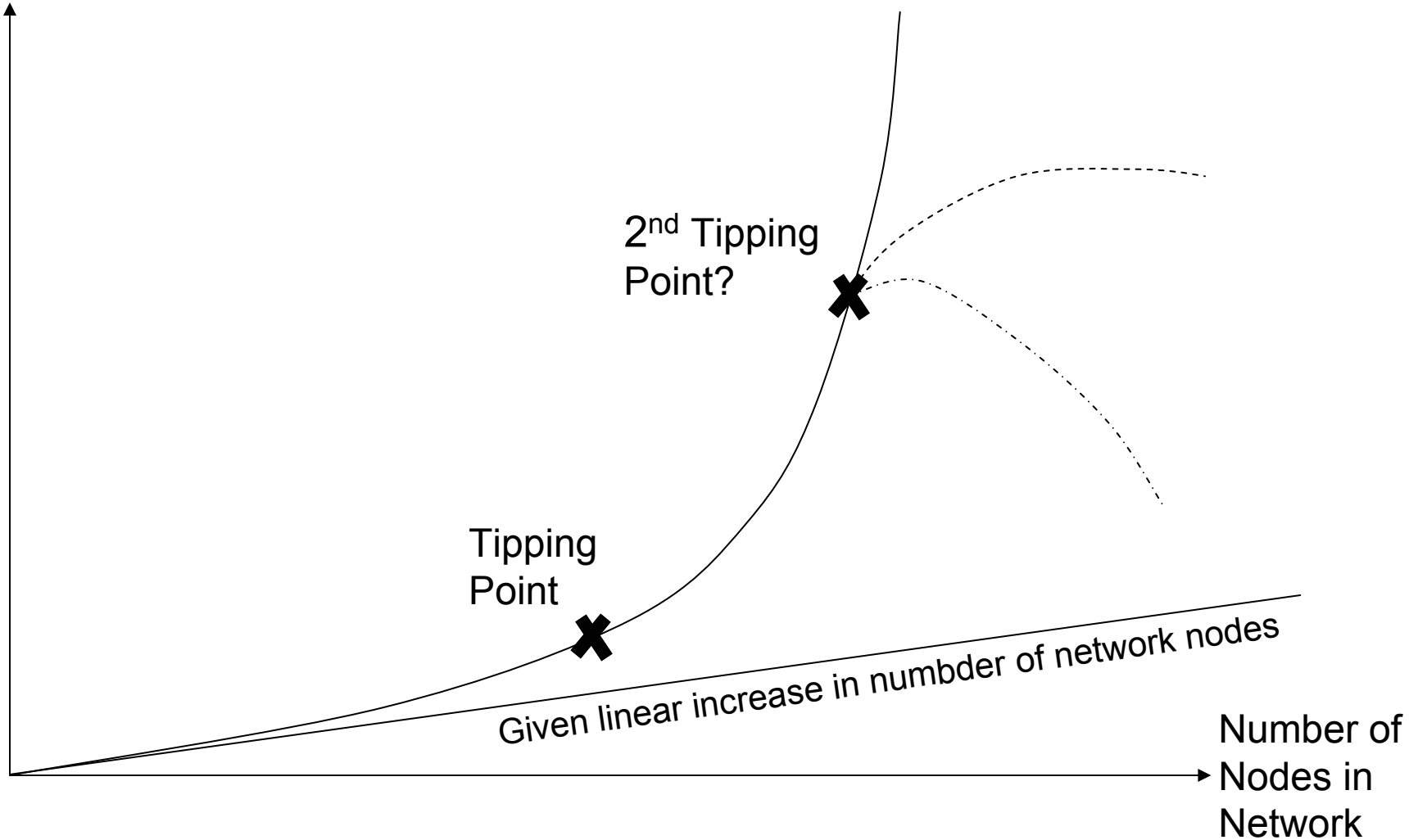


Tipping  
Point

Number of  
Nodes in  
Network

# Metcalfe's Law

Value of network



# Metcalfe's Law

Value of network

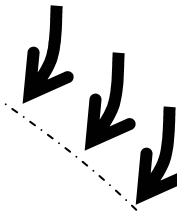
- Excessive Information
- Cognitive overload
- Mitigated when user adapt processes to handle info overload

Suppressive Forces



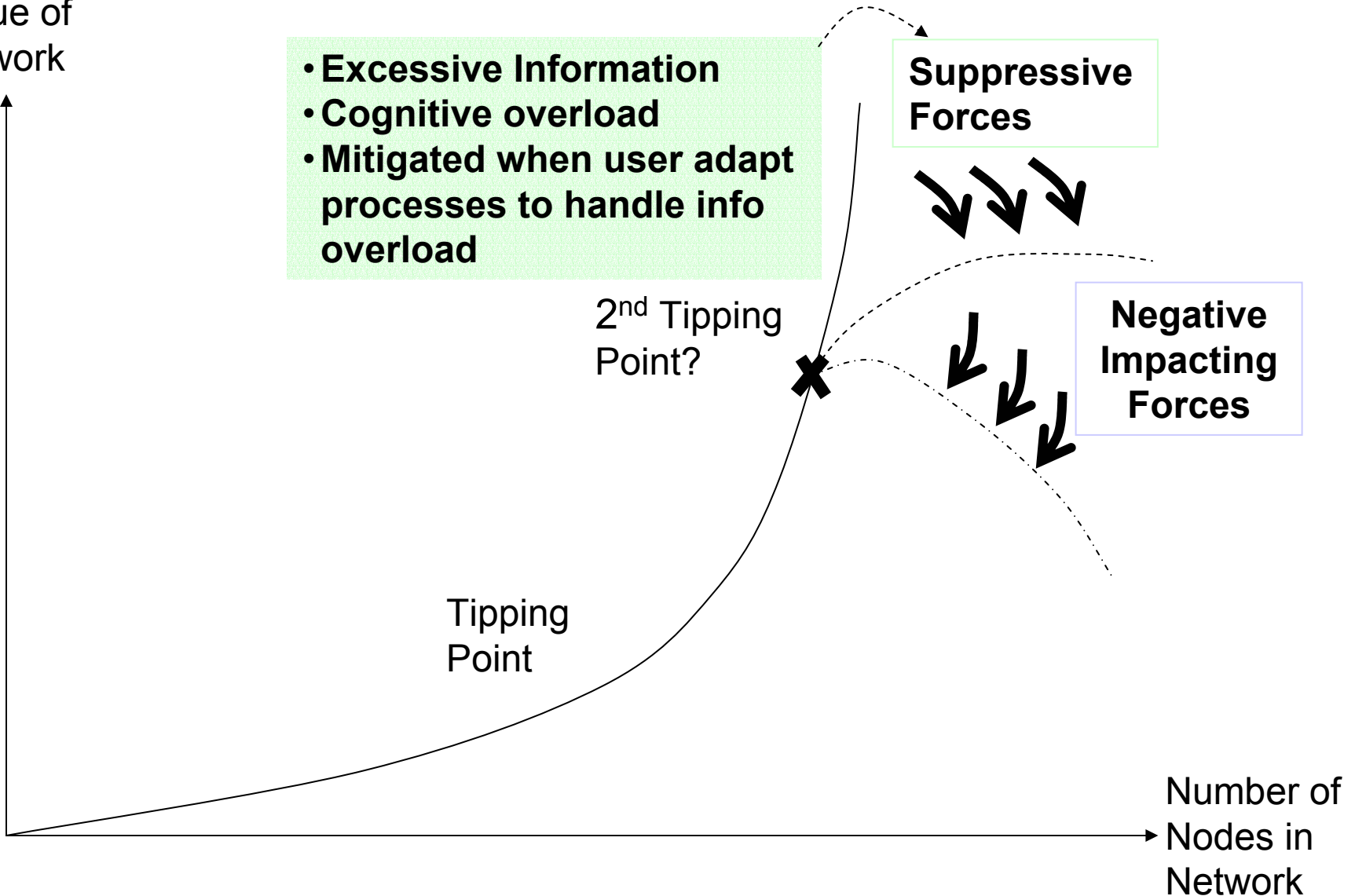
2<sup>nd</sup> Tipping Point?

Negative Impacting Forces



Tipping Point

Number of Nodes in Network



# Metcalfe's Law

Value of network

- Excessive Information
- Cognitive overload
- Mitigated when user adapt processes to handle info overload

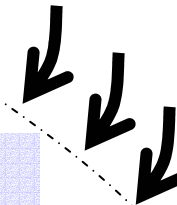
Suppressive Forces



2<sup>nd</sup> Tipping Point?



Negative Impacting Forces

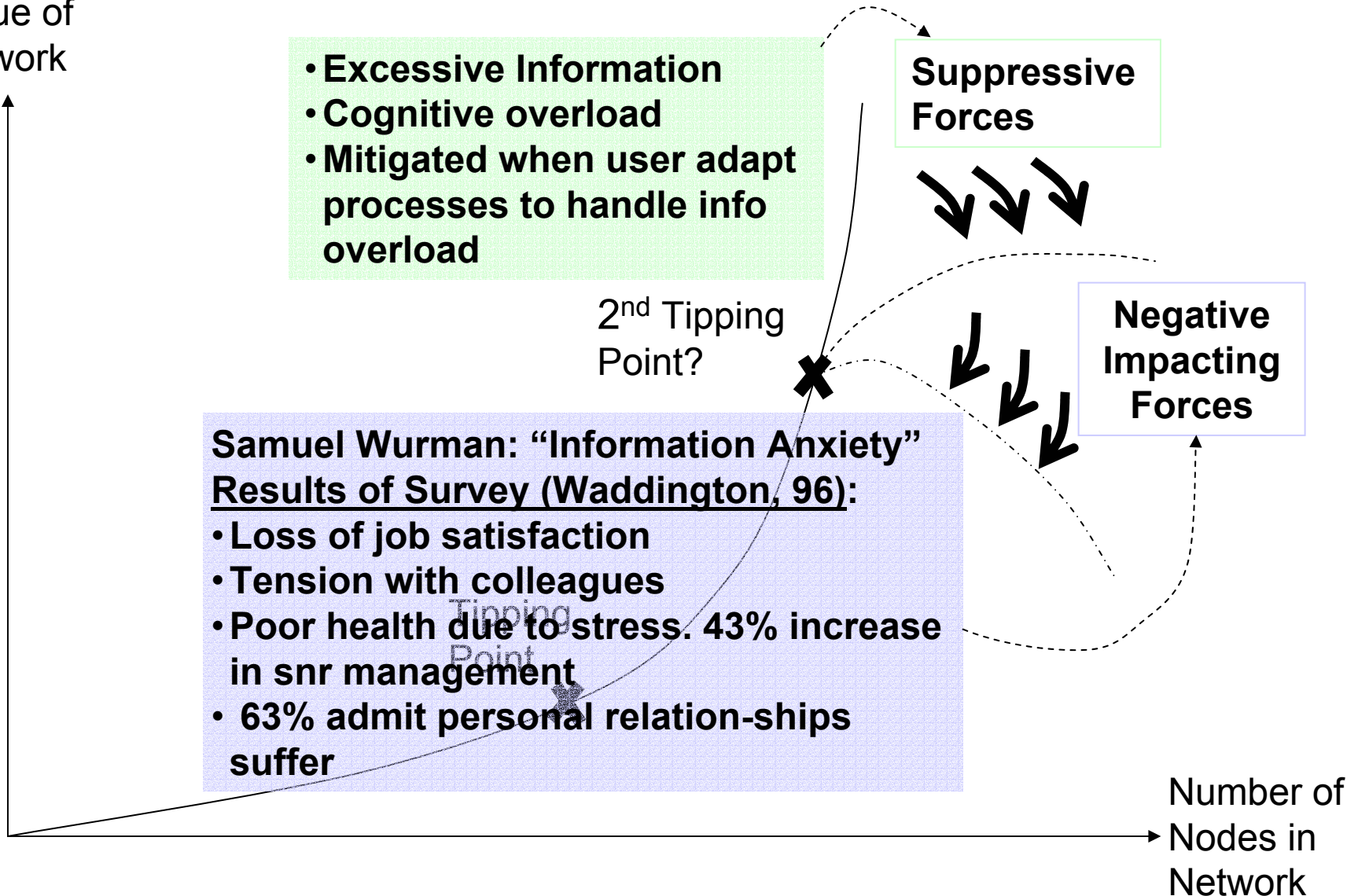


**Samuel Wurman: "Information Anxiety"**  
**Results of Survey (Waddington, 96):**

- Loss of job satisfaction
- Tension with colleagues
- Poor health due to stress. 43% increase in snr management
- 63% admit personal relationships suffer

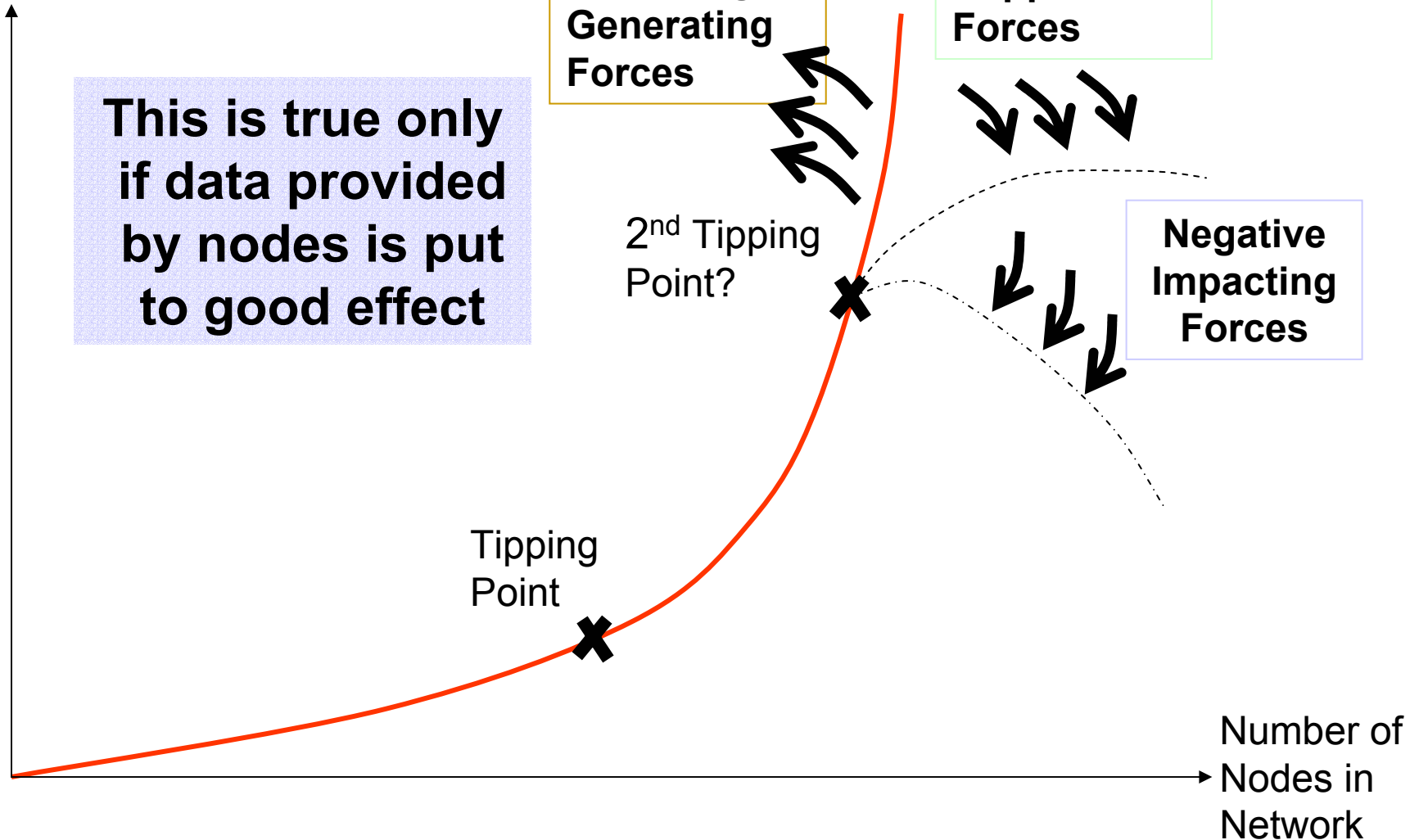
Tipping Point

Number of Nodes in Network



# Metcalfe's Law

Value of network





# Role of the CCIS

- Enable Knowledge-Centric Operations.

*by*

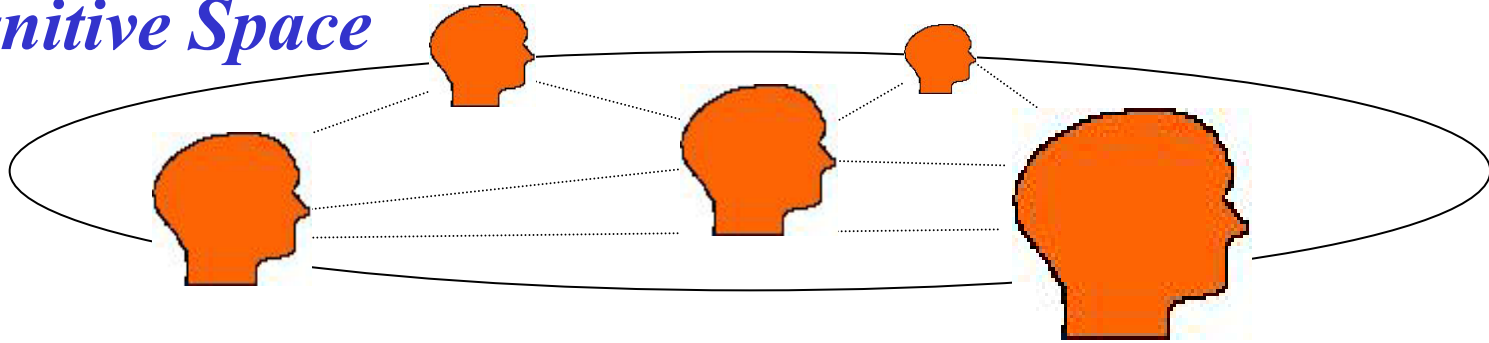
- Helping commanders and soldiers make sense of information and help him make the right decisions.

*by*

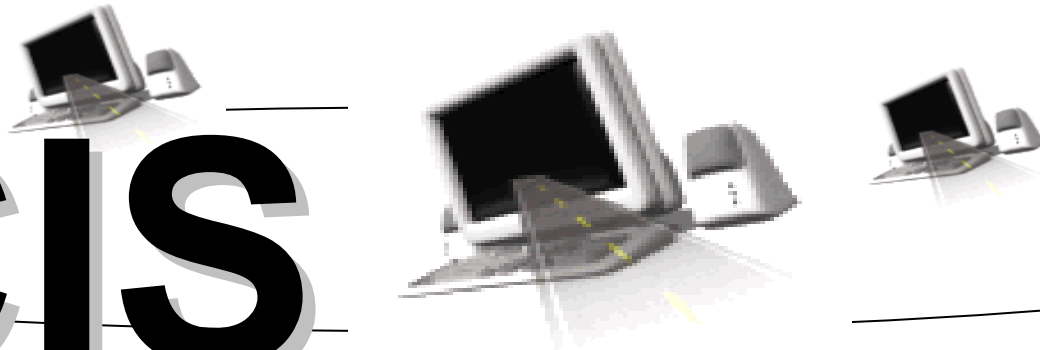
- Fusing the decision-makers' *Cognitive Processes* (visualizing, reasoning, understanding, and decision-making) with the *Information Space*.

# CCIS-An Interface/Medium

*Cognitive Space*



# CCIS



Intelligence Sources



Sensors



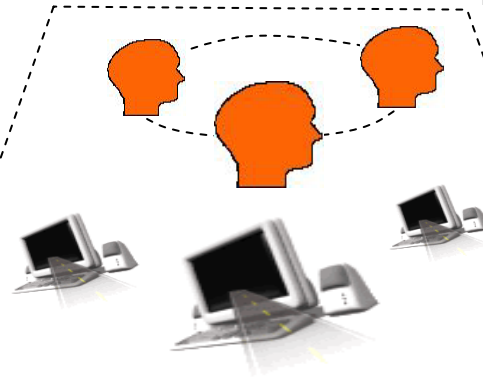
Communications



*Information Space*

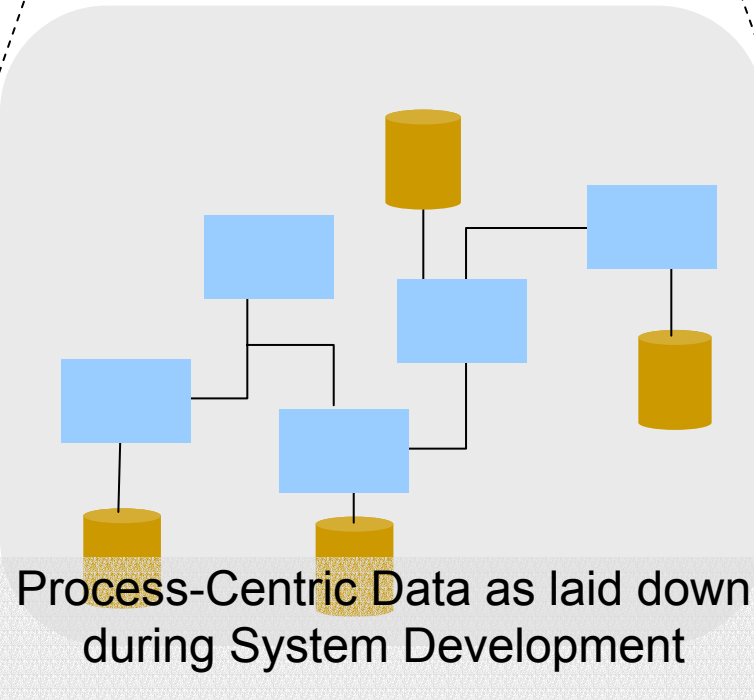
*“potential knowledge”*

# Information Space



## Untapped information Space

*Info / data out there which has not been tapped.*



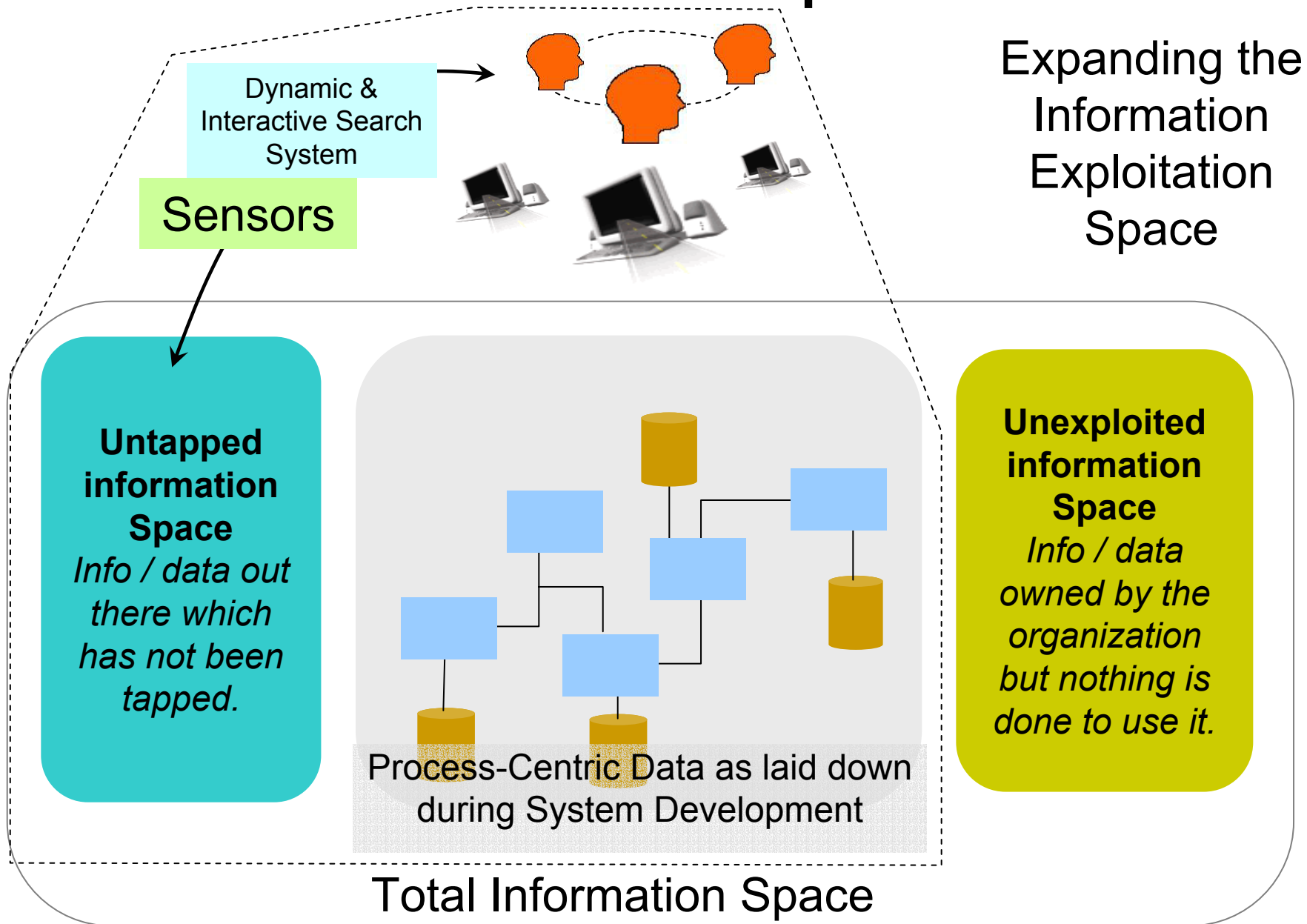
Process-Centric Data as laid down during System Development

## Unexploited information Space

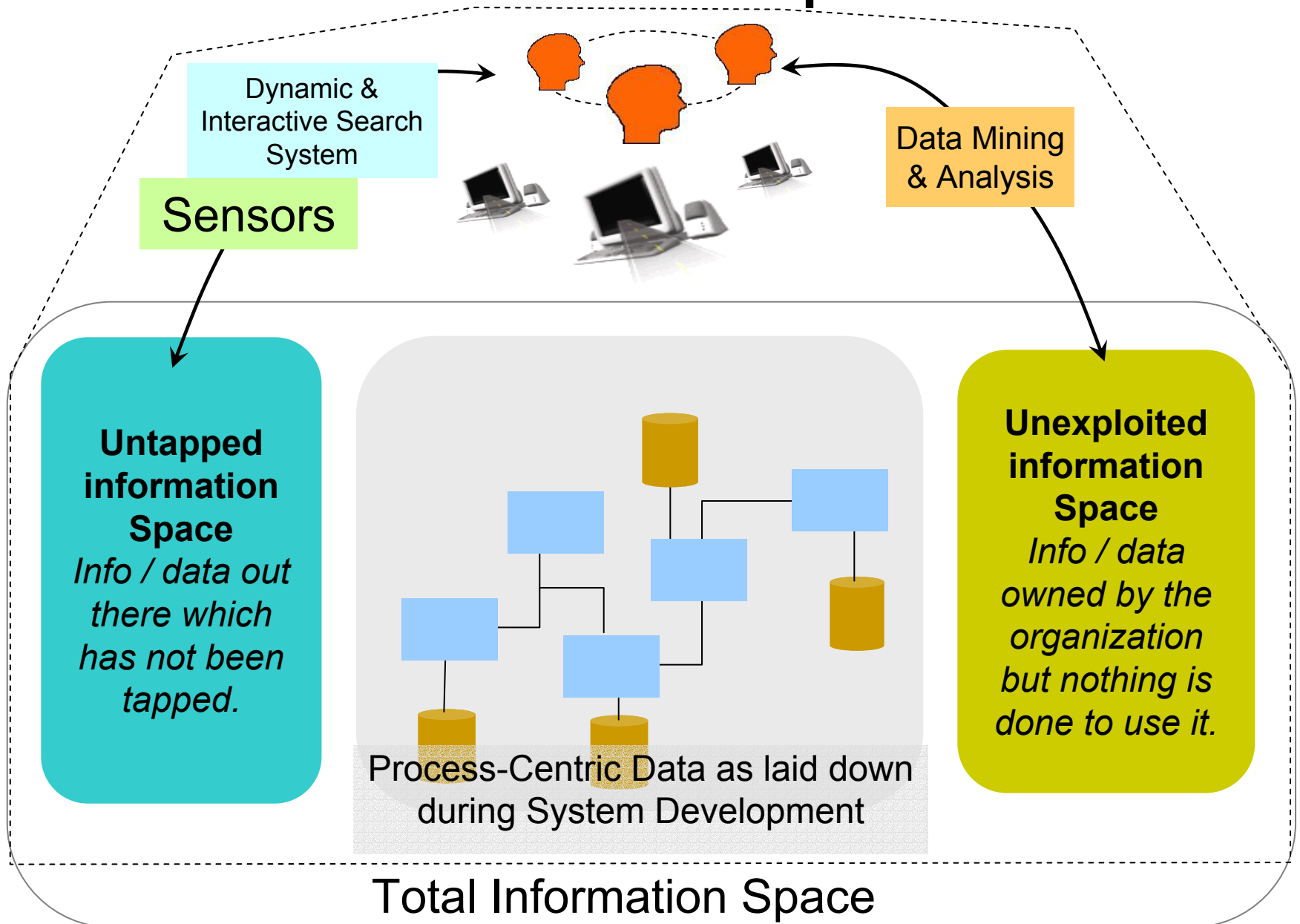
*Info / data owned by the organization but nothing is done to use it.*

Total Information Space

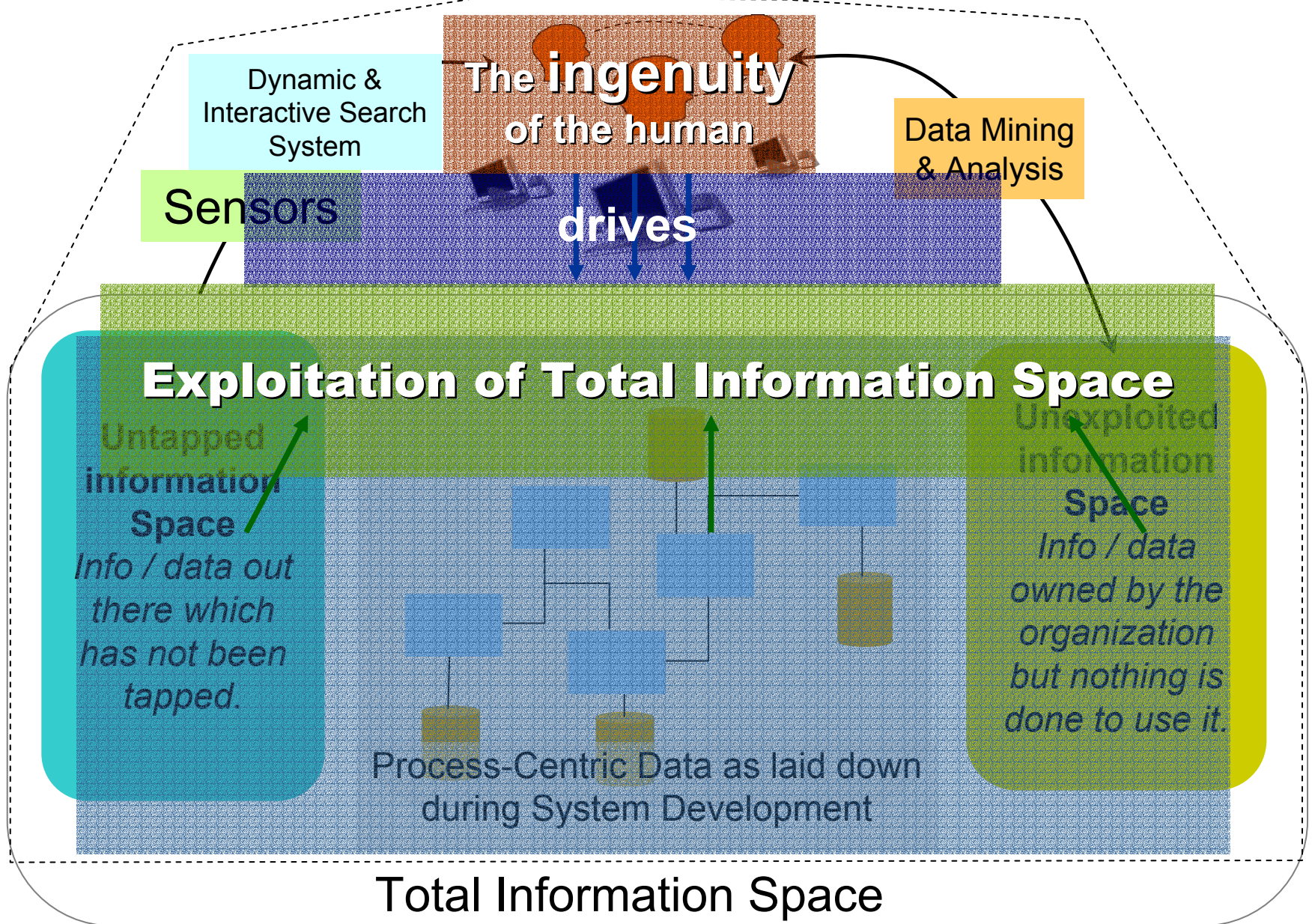
# Information Space



# Information Space

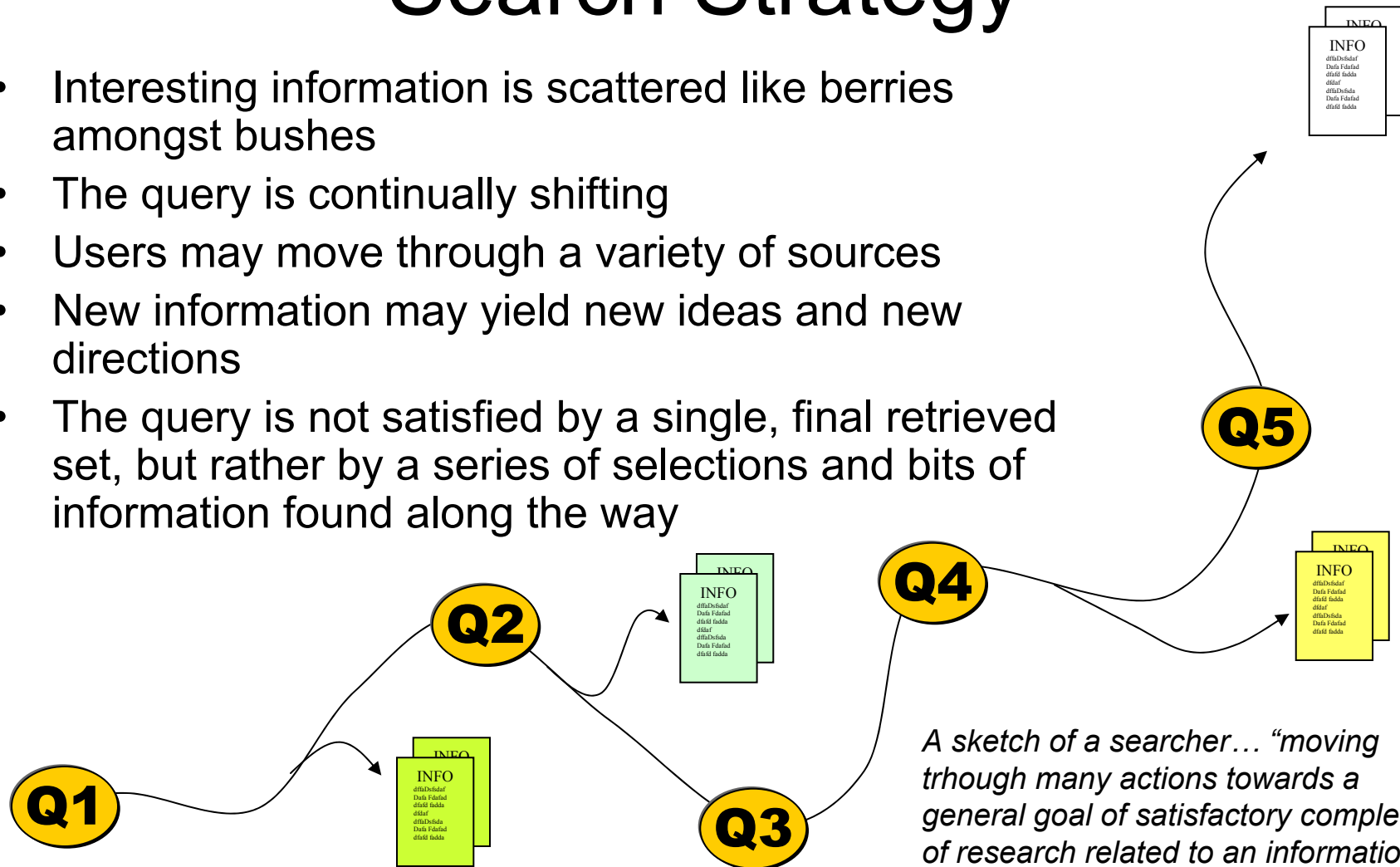


# Information Space



# Berry Picking as an Information Search Strategy

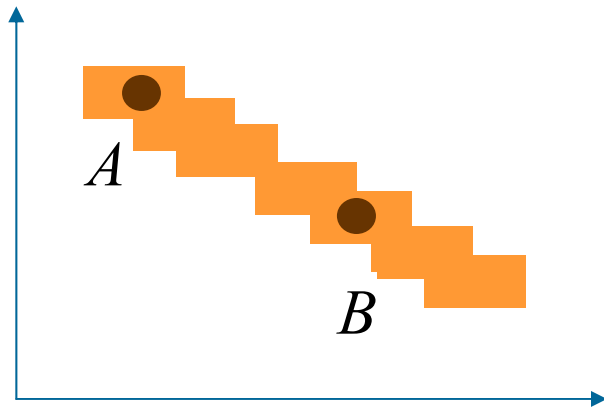
- Interesting information is scattered like berries amongst bushes
- The query is continually shifting
- Users may move through a variety of sources
- New information may yield new ideas and new directions
- The query is not satisfied by a single, final retrieved set, but rather by a series of selections and bits of information found along the way



*A sketch of a searcher... "moving through many actions towards a general goal of satisfactory completion of research related to an information need." (Bates 89)*

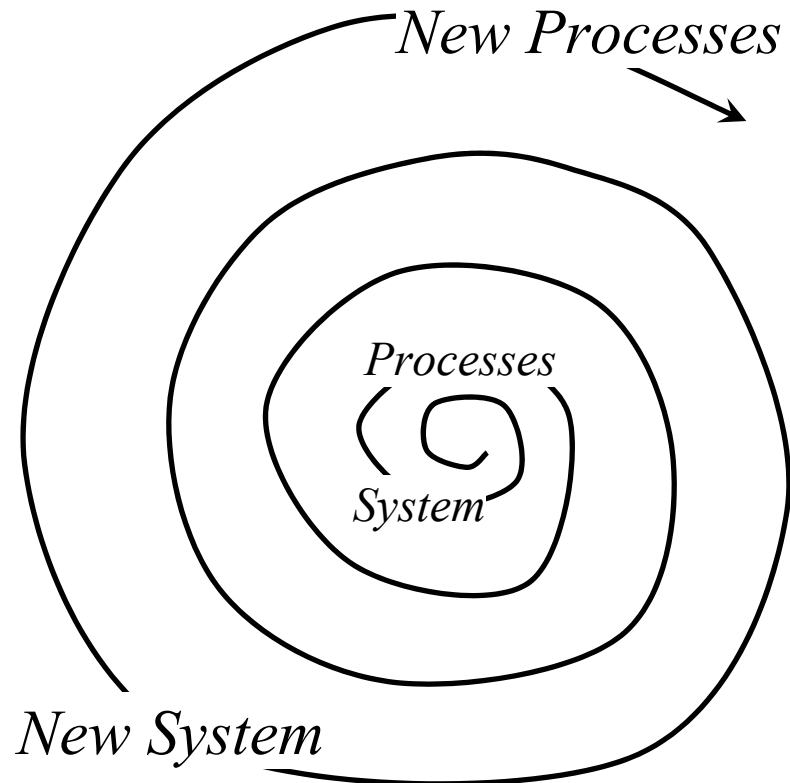
# Cognitive Space : Experiences in CCIS Developments

*Waterfall Model is inflexible & unable to meet ever changing demands*



*Many things change between pt A & B:*

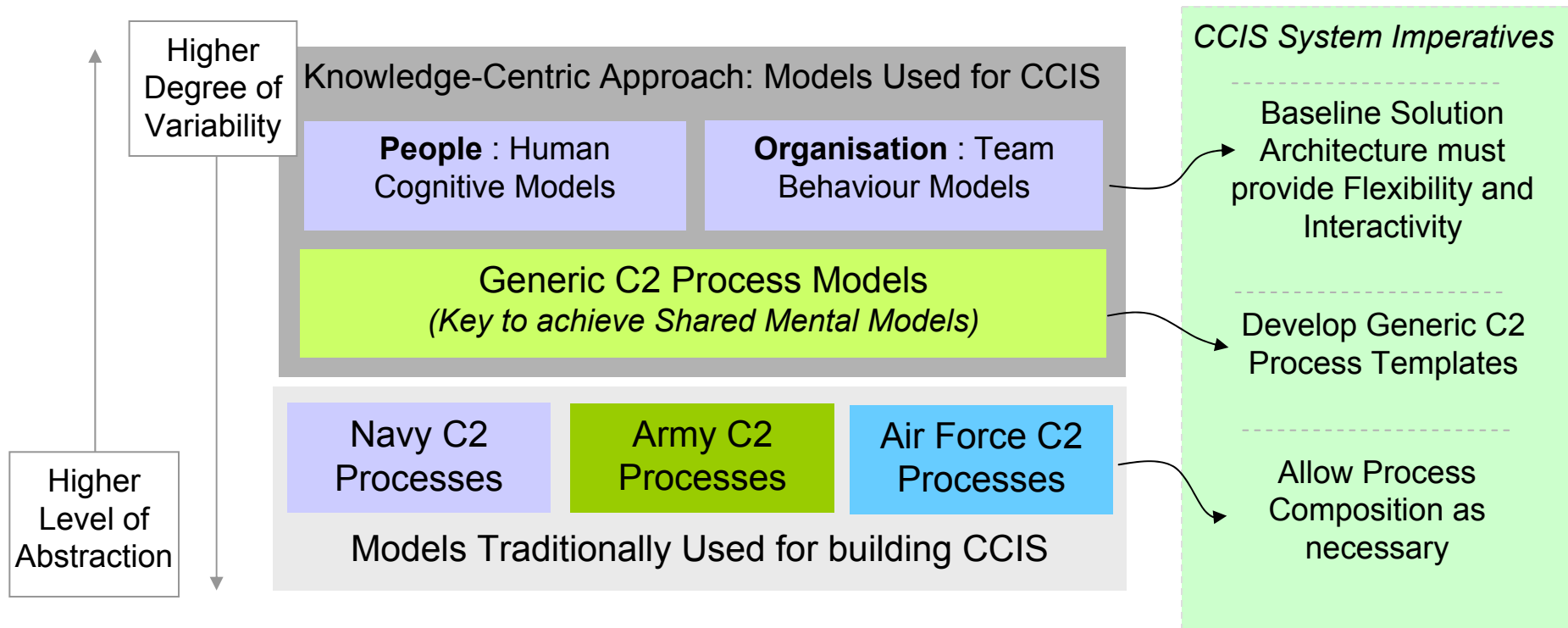
- Transformation
- People & Organisation Changes



*The fact is...system engineering & processes are iterative and spiraling*

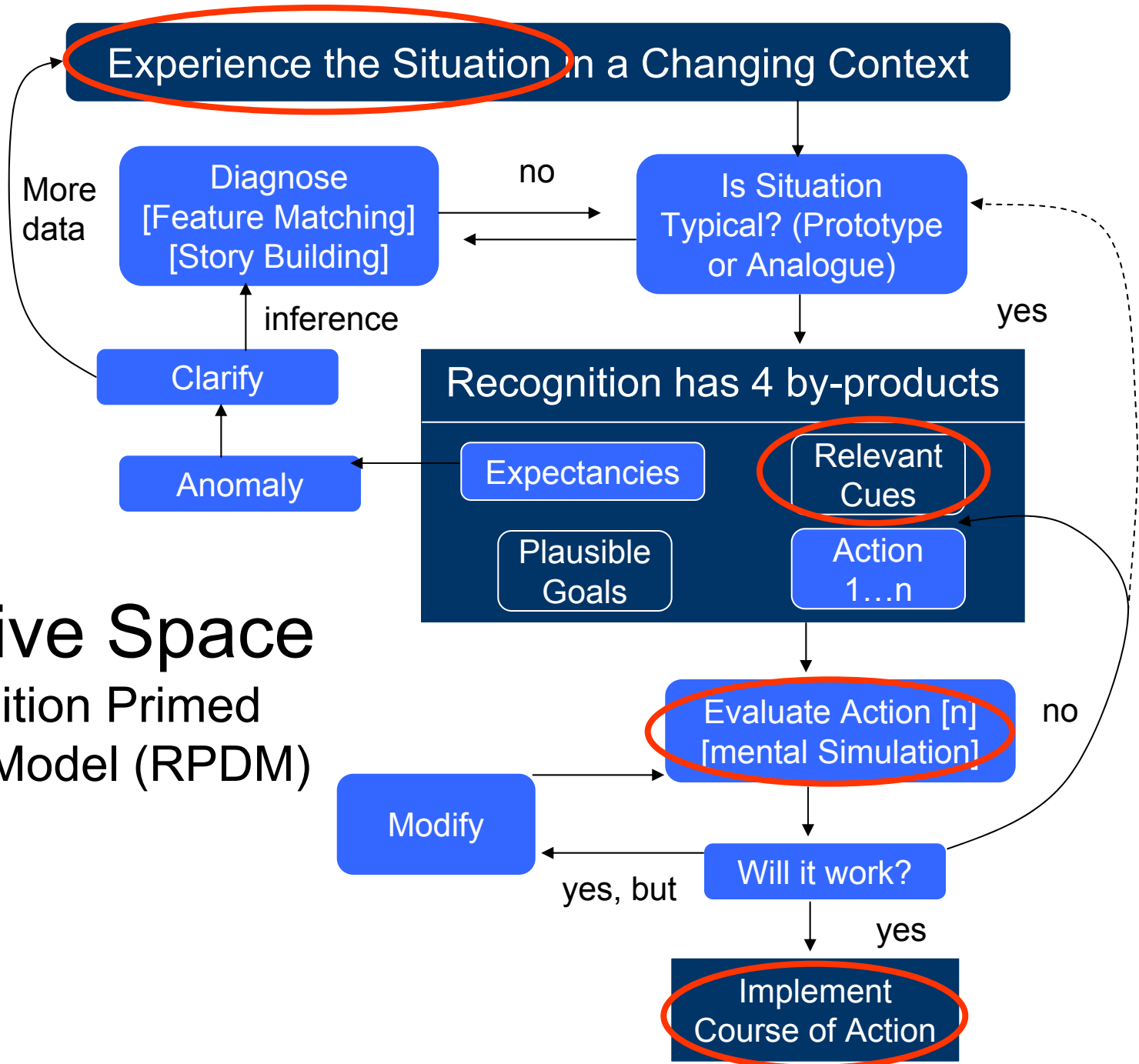


# Levels of Abstraction and Corresponding degrees of variability



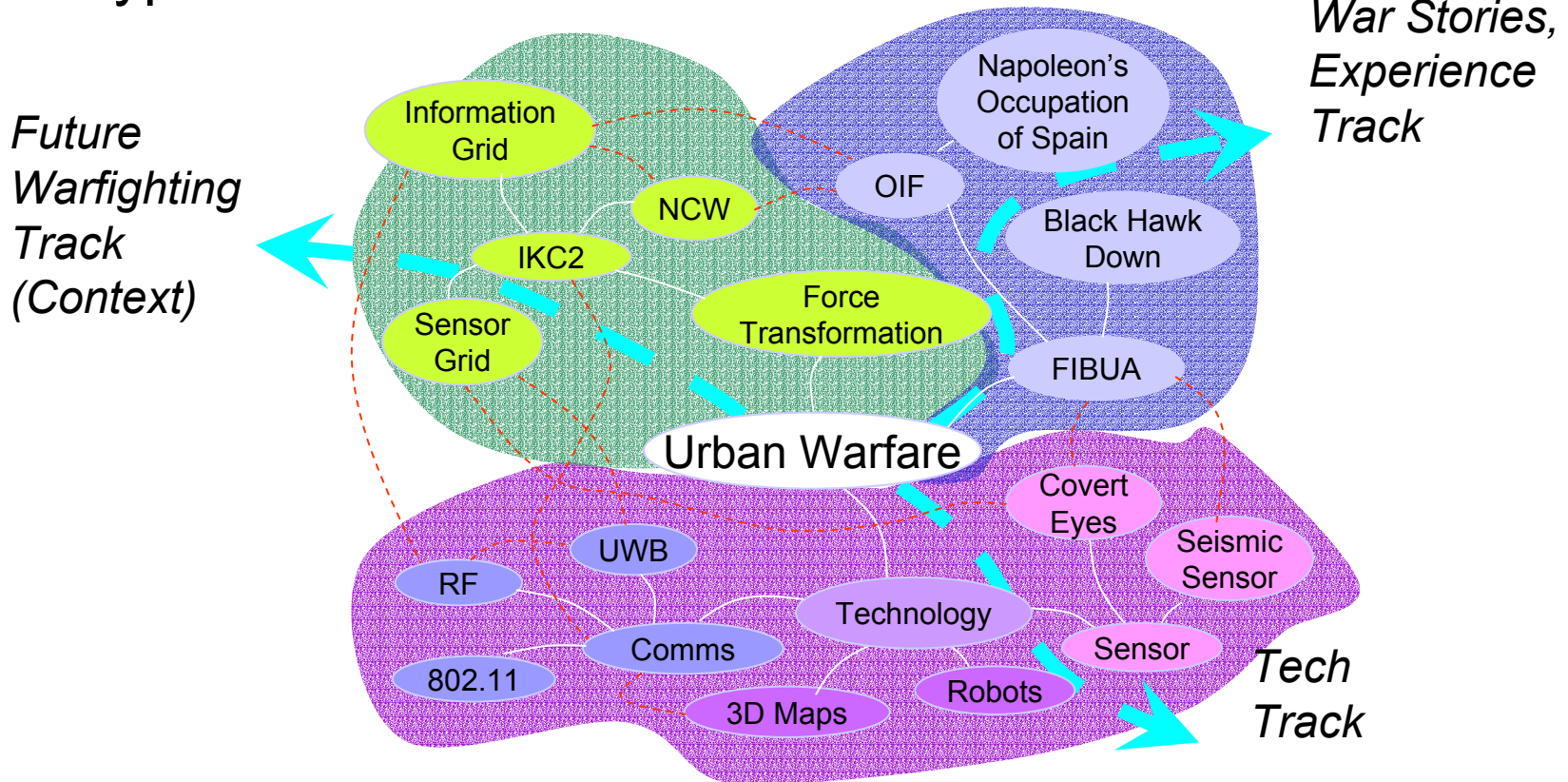
# Cognitive Space

Recognition Primed  
Decision Model (RPDM)



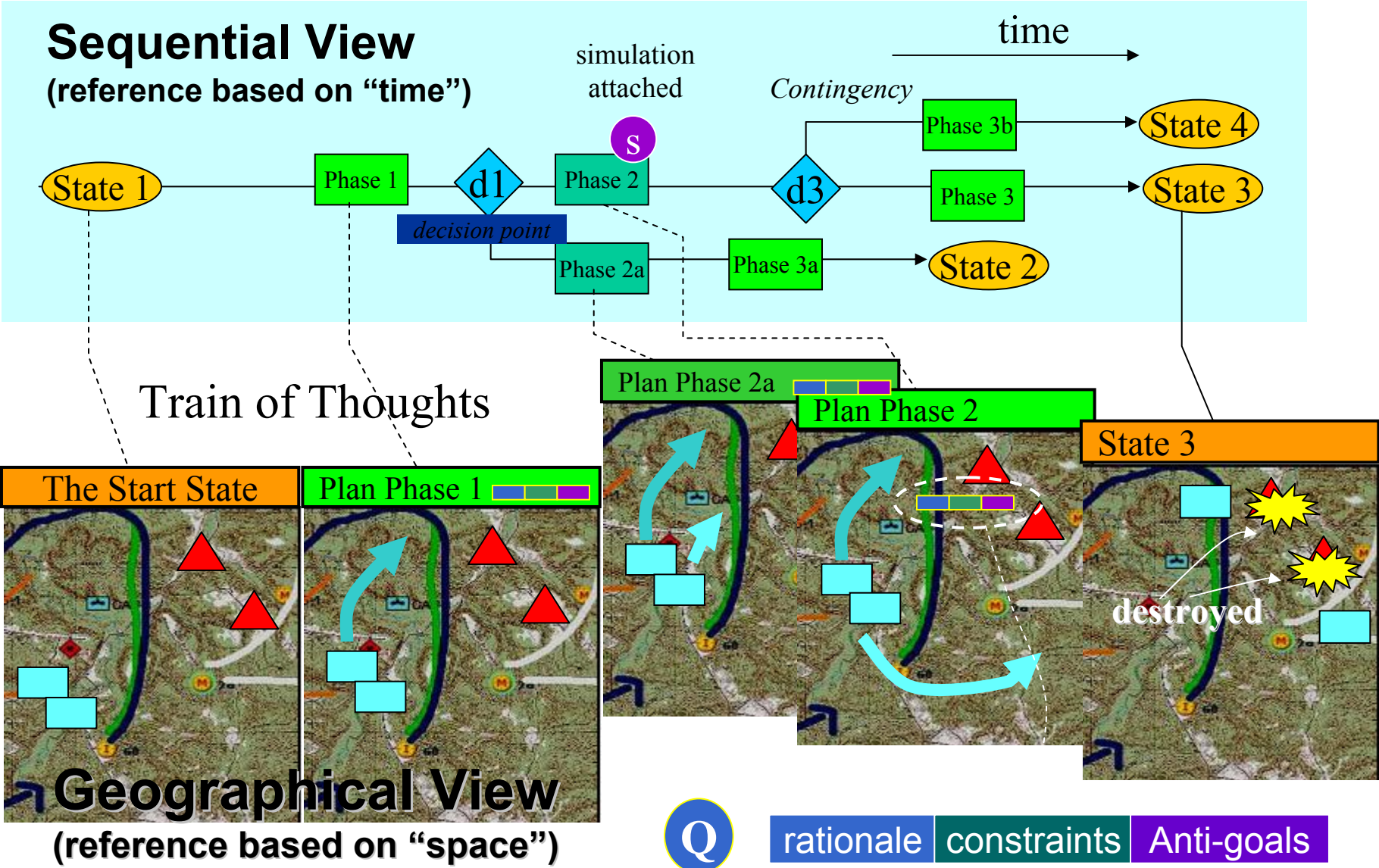
# Cognitive Space – Hyperlinking is Natural

- Knowledge retrieval is associative.
  - Human Associative Model (HAM), by Anderson and Bower.
  - Spreading Activation Theory by Collins and Loftus
- Hypertext

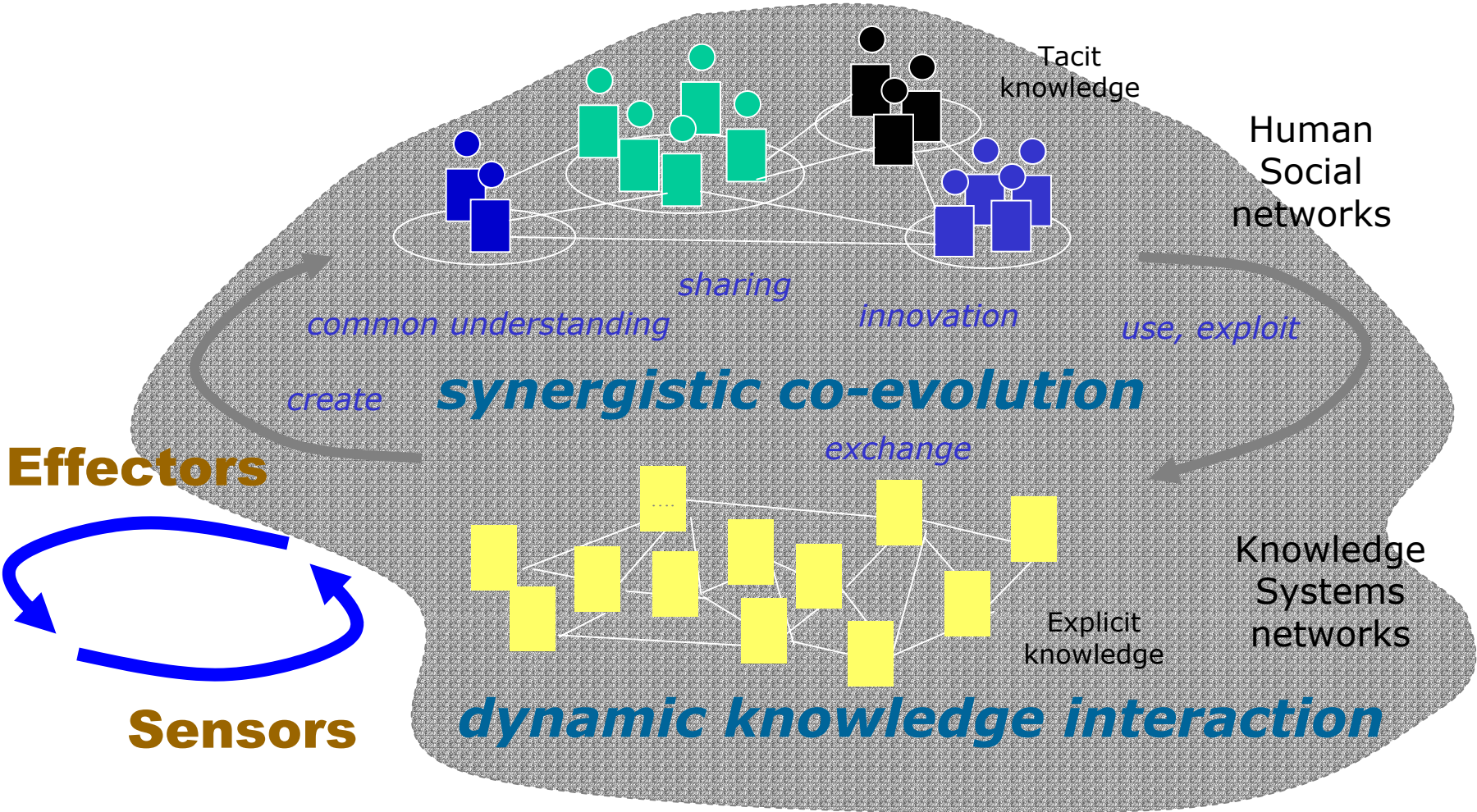


# Cognitive Space – Thinking is Structural (Gestalt Psychology)

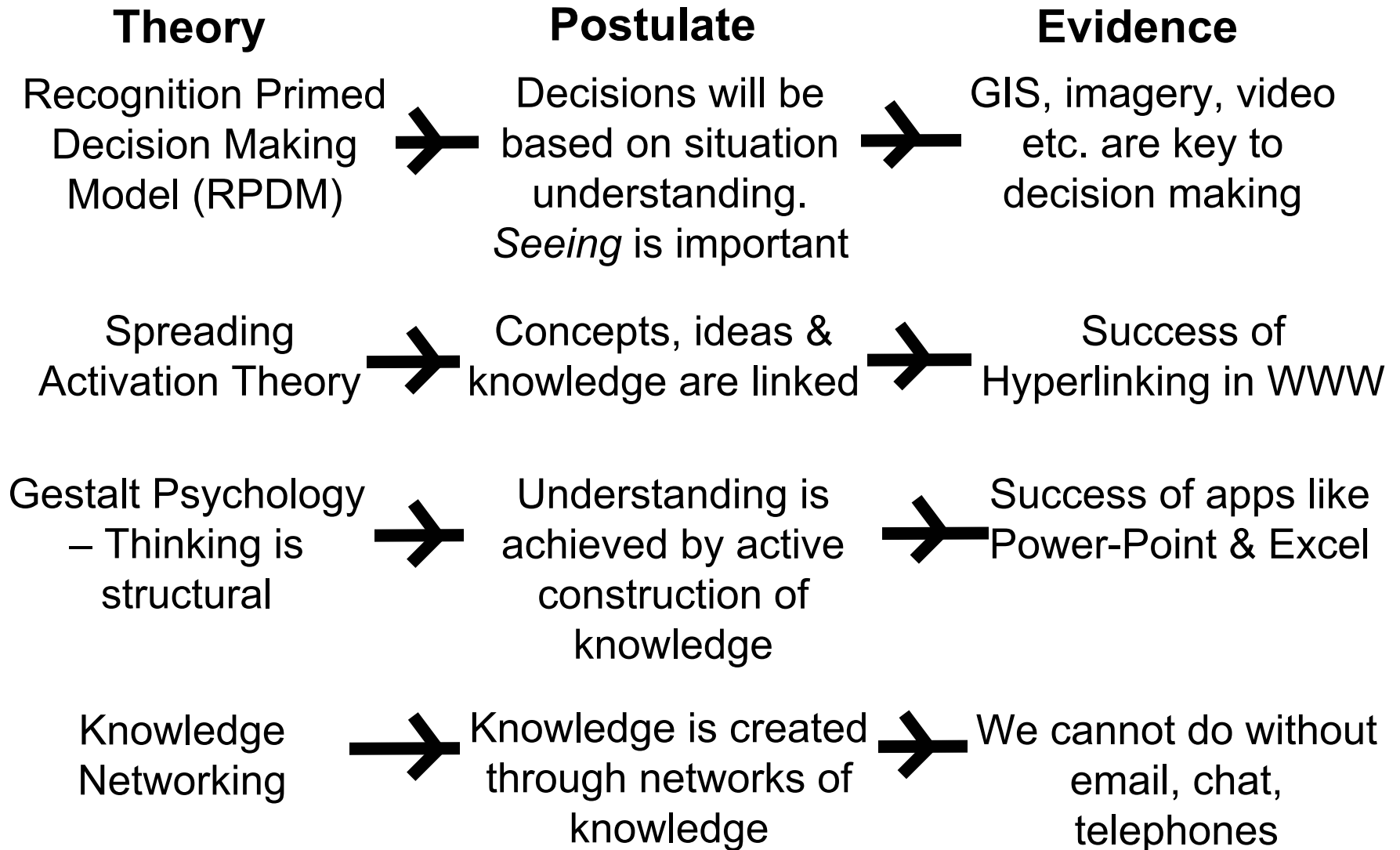
The Analysis of the Situation / The Ops Order / The Evolving States



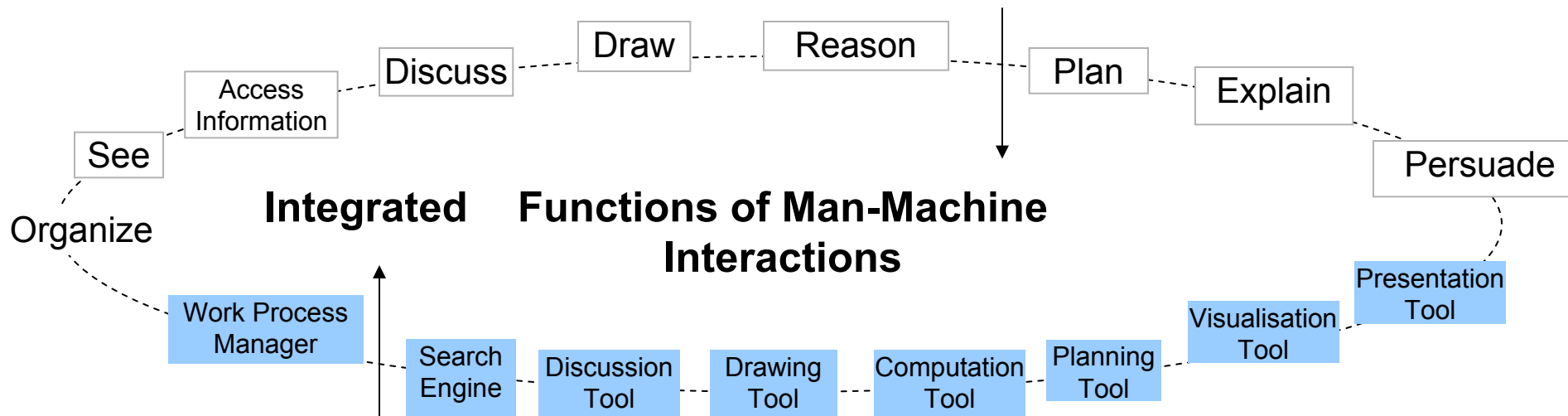
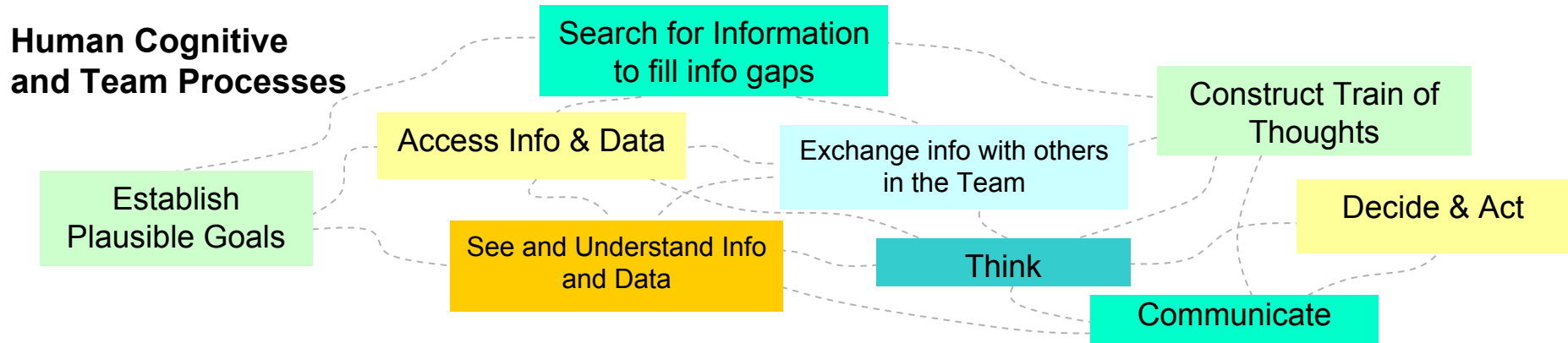
# Cognitive Space - Knowledge Network



# Cognitive Space

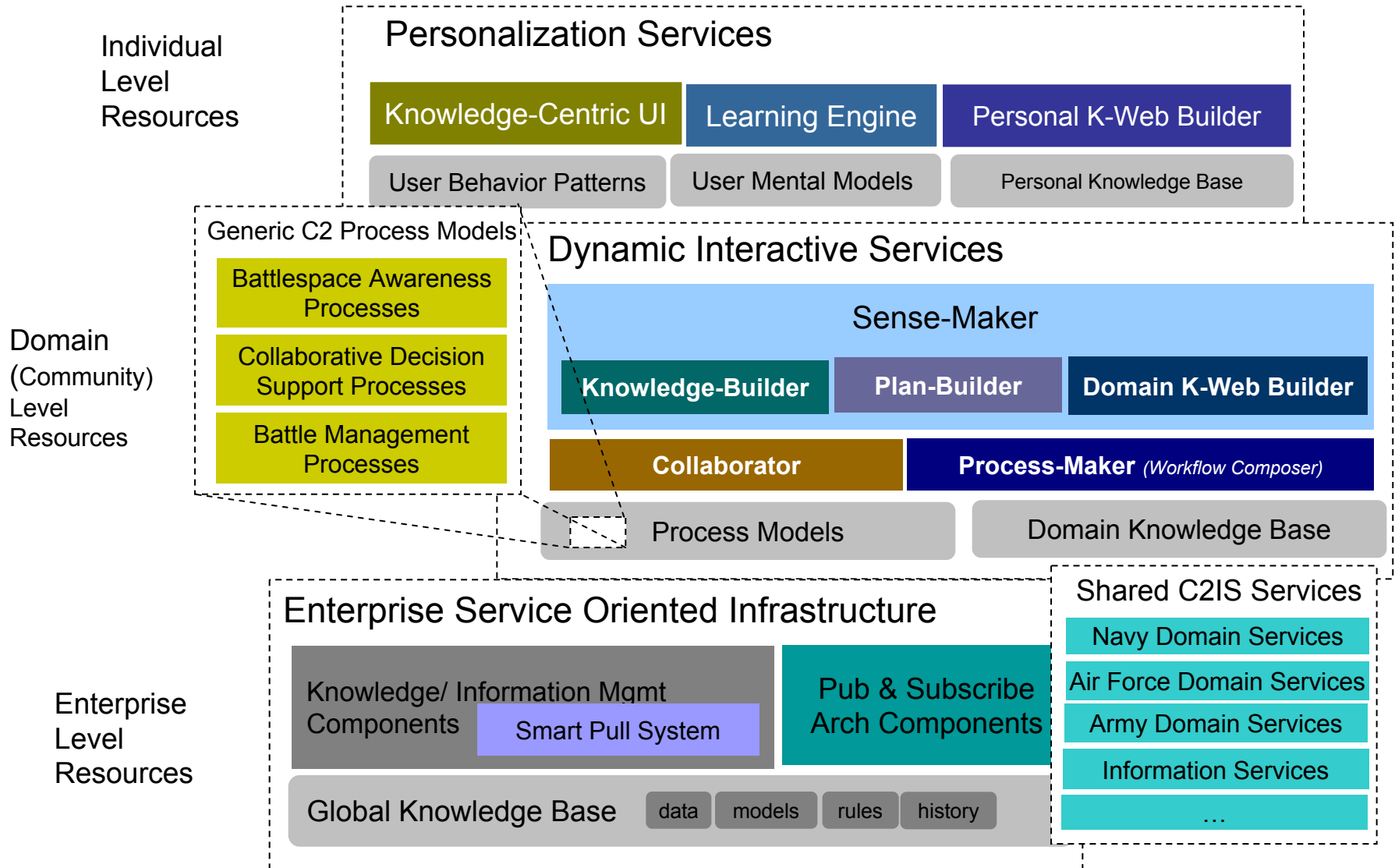


# What are the basic features that a CCIS should provide? (Baseline Solutions Architecture)





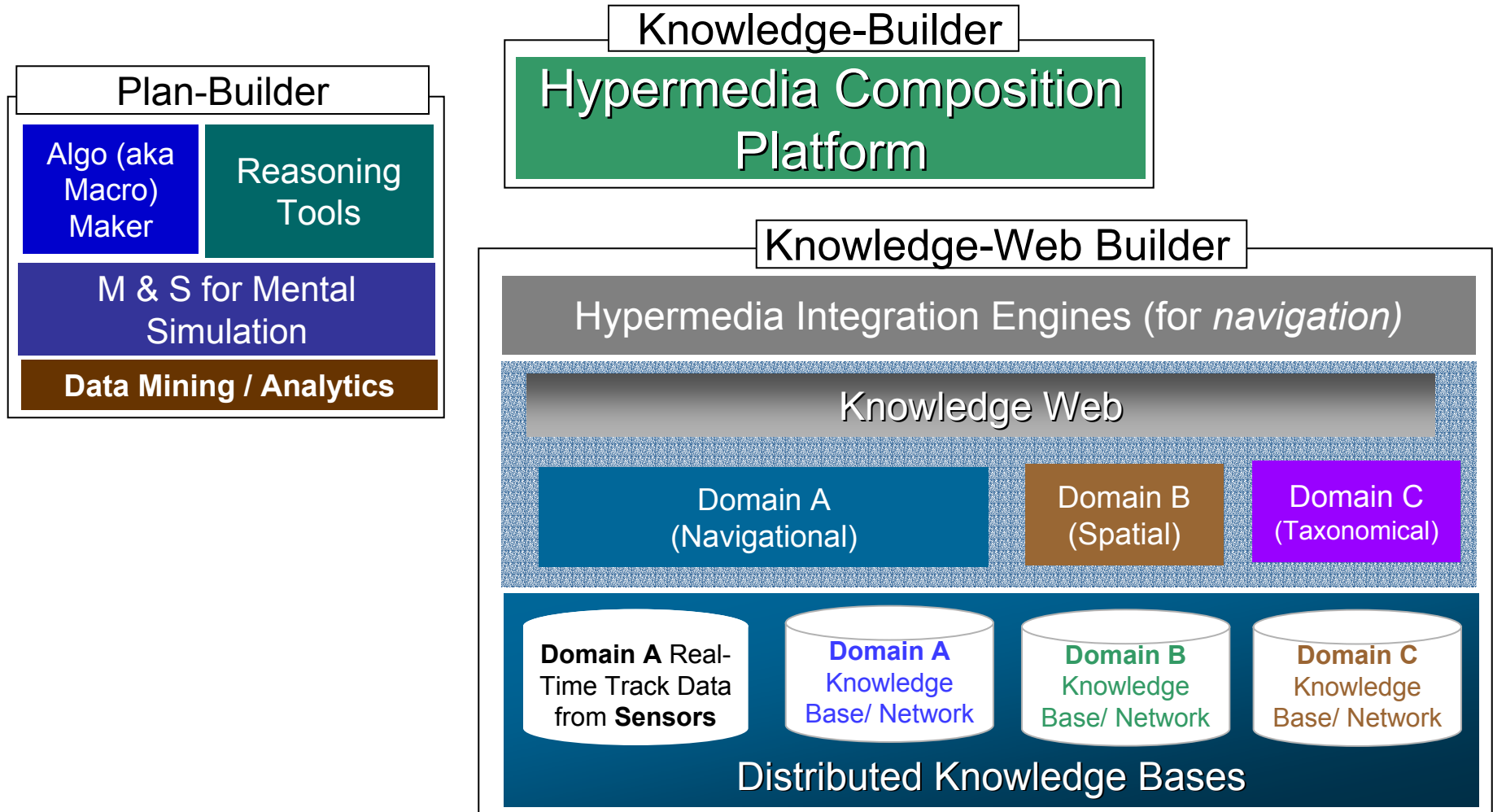
# C2KS Architecture





# Sense-Maker Architecture

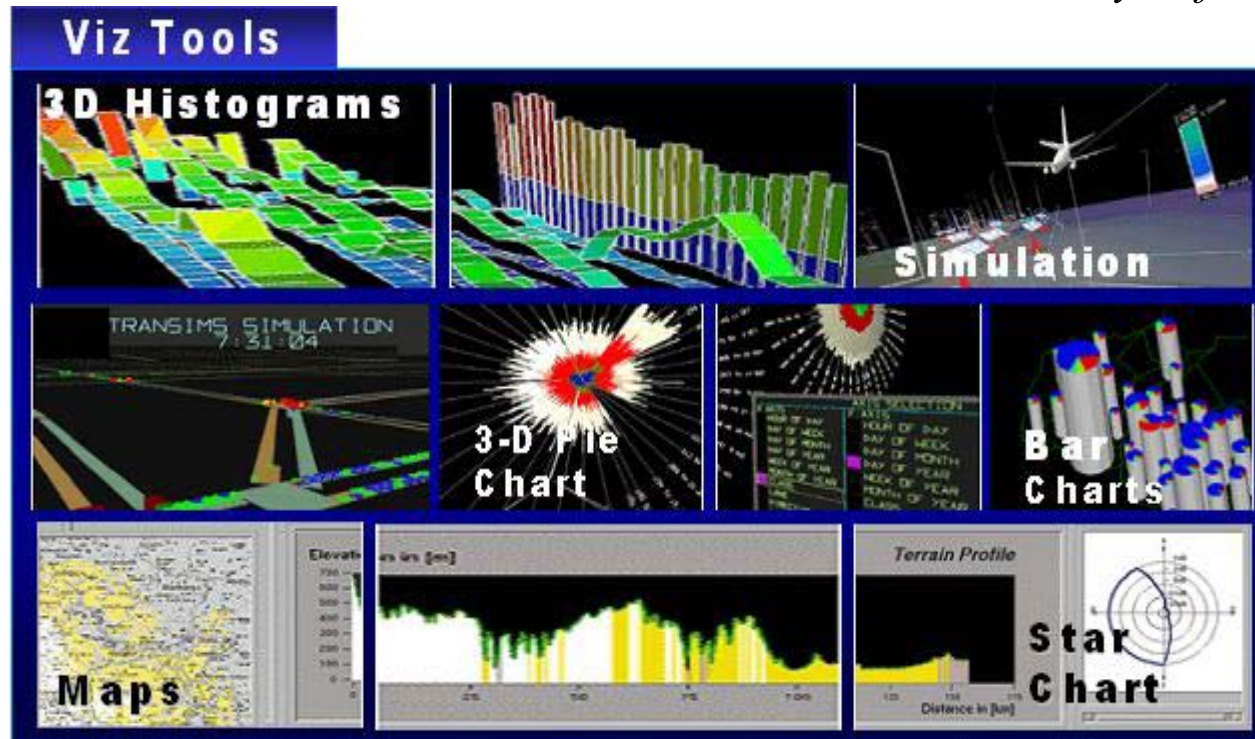
*for ad-hoc construction of thoughts*



# Knowledge Builder

A palette of visualization options giving info users a variety of means to explore his information or data.

*“Ways of Seeing”*



Need to establish how to best present information

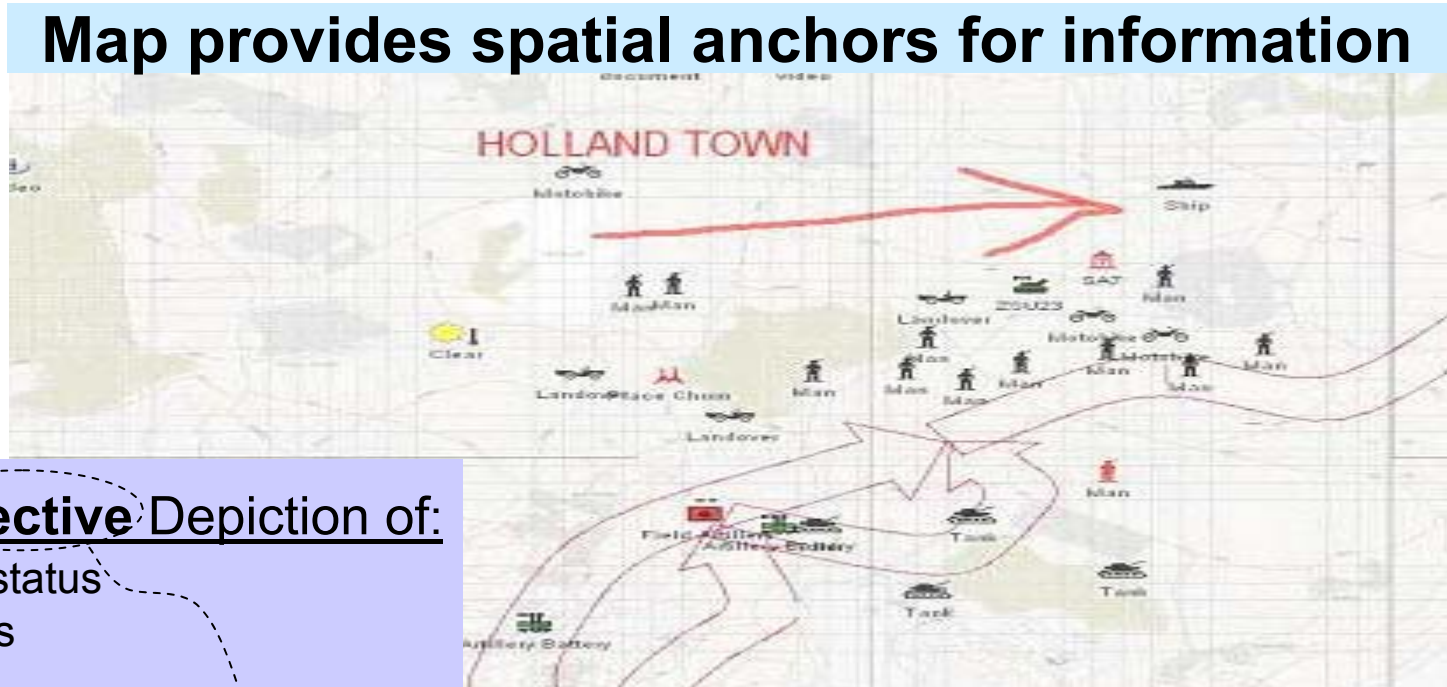
Need to offer the user multiple perspectives to look at the same piece of information => insights

Need to provide users with a means to explain an idea, or a plan.

# Knowledge-Web Builder : Spatial Hyperlinks

Spatial

Map provides spatial anchors for information



Enable **Effective** Depiction of:

- Own forces status
- Enemy status
- Movements
- Environment
- Intention & Plan
- Incidents & Events

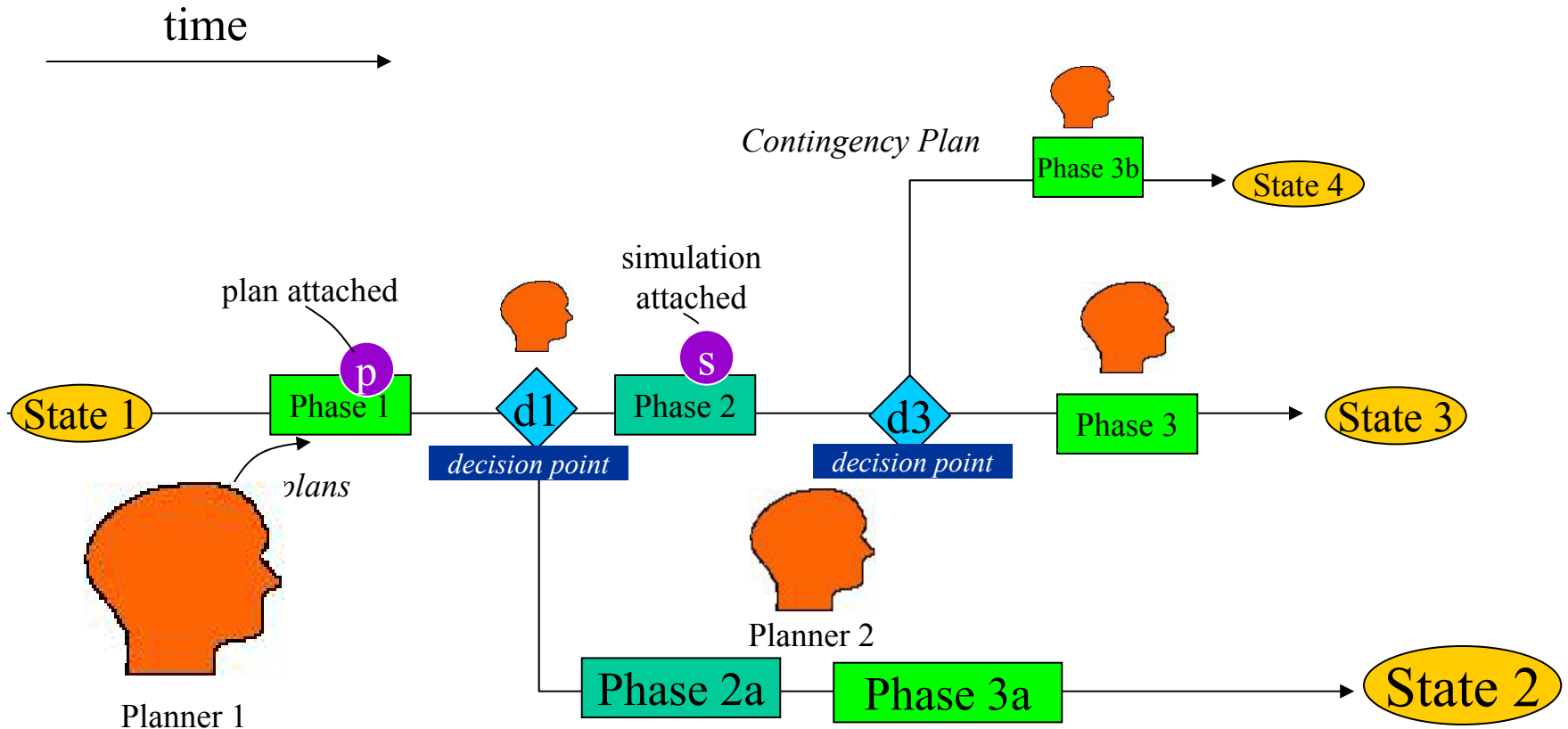
Spatial features gives immediate appreciation of geography-based info. Imagine having to explain position & movements of own forces in text!

Spatial reference points help relate events to location. E.g. terrain effects on tank maneuvers occurred at the same spot in the past.

“As we may think” *Vannevar Bush*

# Process-Maker Architecture

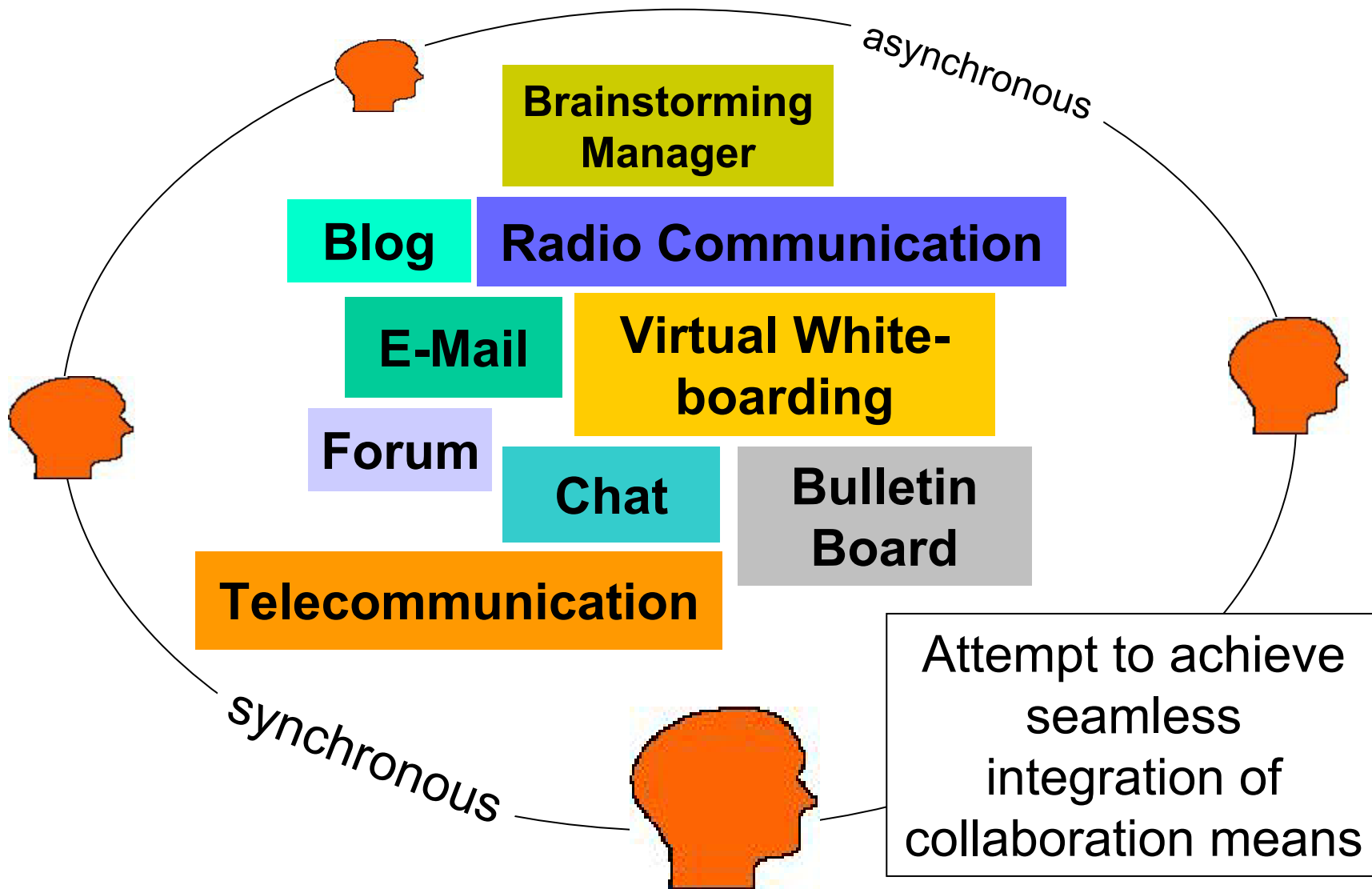
*for ad-hoc construction of processes*



**Gives users power to construct organizational processes in ad hoc manner**

# Collaborator

*connecting people*



# Mission Mate – Service Oriented Architecture

Microsoft Internet Explorer

Address: <http://cottontail/products/Channel/collaborator.htm>

## Common Operating Picture (Prototype)

Home | Contact Us | Using this Site

**About Us**

- Our Mission
- Members

**Our Services**

- Active Console
- Enterprise Portal
- Instant Messenger
- Mobile PDA
- this client
- Web Services

**Our Products**

- Basic Planner
- Costs Propagator
- CO Ops. Pictors
- Approach Viewer
- Covered CD Viewer
- GAFF Viewer
- ACS Viewer
- Infed Viewer
- Resource Viewer
- Tracks Viewer
- Services Viewer
- User data Viewer
- 3D Technical Viewer

**ADA Planner**

- Air Request Planner
- Approach Planner
- Aircraft Tracker

**Note:**

1. A Java 1.4+ Pluggin (Win 98/2000/XP, Linux) must be installed to run applet/application.
2. Guest user, please login using this account ( ID: guest, Password: password, Server: cottontail)
3. Also, try our Java Webstart packaging: [collaborator.jar](#)

File Edit View Map Help

Map Concepts Reports Schedule

01 102076 100 50281 1:200,000 Pan Map [Left Drag]-Scroll [Right Double Click]-Zoom

Object Attributes

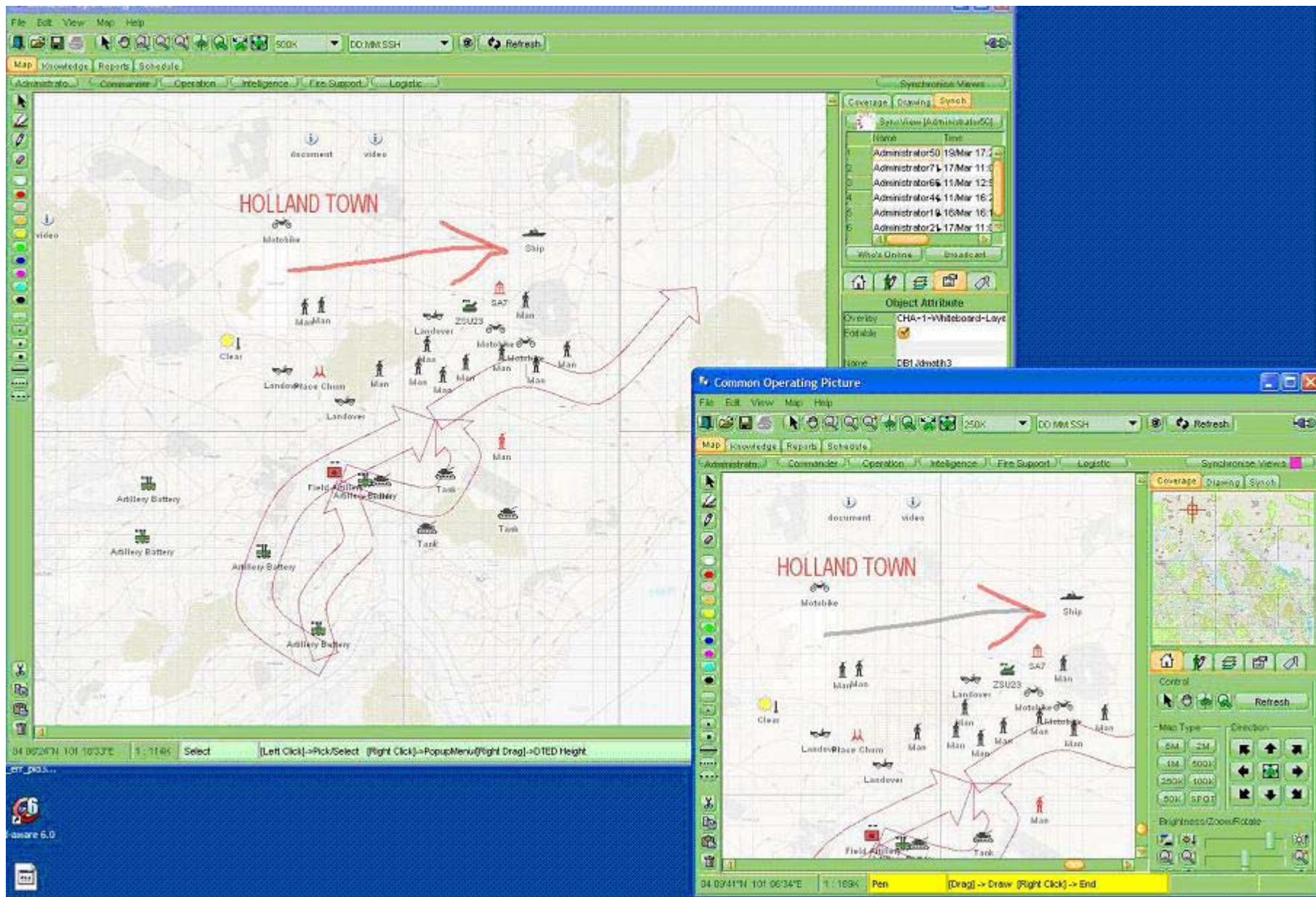
Property	Value
Color	and-Lab
Stroke	
Width	
Line Width	2
Line Style	Solid
Line Color	Red
Fill On	<input type="checkbox"/>
Fill Style	
Fill Color	Blue
Remark	

Applet Channel started

Local intranet



# Mission Mate – Information Architecture





# Mission Mate – Information Architecture

The image displays the Mission Mate software interface, which is a Common Operating Picture (COP). The main window shows a map of Holland Town with various icons representing military units and assets. A red line traces a path through the town. A WordPad window is open in the foreground, displaying XML data for a runway.

**Map Labels:** HOLLAND TOWN, Metobike, Ship, Man, Landover, 25U23, SAT, Landover, Landover, Landover, Field Artillery Battery, Tank, Tank, Tank, Artillery Battery, Artillery Battery, Artillery Battery, Artillery Battery.

**WordPad Content:**

```
<SECOND_ARPT>null</SECOND_ARPT>
<OPR_AGY>CS</OPR_AGY>
<SEC_NAME>null</SEC_NAME>
<SEC_ICAO>null</SEC_ICAO>
<SEC_FAA>null</SEC_FAA>
<SEC_OPR_AGY>null</SEC_OPR_AGY>
<CYCLE_DATE>200202.0</CYCLE_DATE>
<LAST_UPDATE_TIME>19/03/2004 17:37:30 </LAST_UPDATE_TIME>
<RUNWAYS>
<ARPT_IDENT>SN90056</ARPT_IDENT>
<HIGH_IDENT>20L</HIGH_IDENT>
<LOW_IDENT>02R</LOW_IDENT>
<HIGH_HDG>203.0</HIGH_HDG>
<LOW_HDG>23.0</LOW_HDG>
<LENGTH>13123</LENGTH>
<RWY_WIDTH>197</RWY_WIDTH>
<MAX_RWY_WIDTH>197</MAX_RWY_WIDTH>
<SURFACE>ASP</SURFACE>
<PCN>072FBWU</PCN>
<HE_LATITUDE>4903672</HE_LATITUDE>
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<HLGT_SYS_5>9</HLGT_SYS_5>
<HLGT_SYS_6>27</HLGT_SYS_6>
<HLGT_SYS_7>50</HLGT_SYS_7>
<HLGT_SYS_8>0</HLGT_SYS_8>
<LE_LATITUDE>4783691</LE_LATITUDE>
```



# Mission Mate – Time Slider for Mission Rehearsal

The screenshot displays the Campaign Planner (Network Mode) interface. The main map shows a mission route with waypoints 1 through 8. Two specific waypoints are highlighted: 'Sortie303' and 'Sortie600'. A time slider at the bottom of the map is currently set to 'PAUSE' at 19/03/2004 18:10:09. The slider shows 'Step 20', 'Start: 19/03/2004 17:58:27', and 'End: 19/03/2004 18:28:17'. The status bar at the bottom indicates coordinates '03 53:09"N 101 09:58"E', a scale of '1 - 473K', and a 'Select' mode. It also provides instructions: '[Left Click]->Pick/Select [Right Click]->PopupMenu(Right Drag)->DTED Height'.

**Campaign Planner (Network Mode)**

File Campaign Information Map Tools Utilities Help

500K DC-MM-SSH Refresh

Map Packages Schedule

Sortie303 Sortie600

Waypoint

Type	NV
Name	
Code	
Altitude	0
Elevation	0
ETA	19 17:58:27
Total Time	00:09:23
FR	0
FRCS	0
Turn Type	Overfly
AOB	60
G Turn	
Heading	75.253
Altitude	0
Safety Alt.	0
Speed	450
Fuel Used	0
Leg Time	00:01:52
Leg Dist.	14.005
Dist.Type	Great Circle
Temperature	15

03 53:09"N 101 09:58"E 1 - 473K Select [Left Click]->Pick/Select [Right Click]->PopupMenu(Right Drag)->DTED Height

Thank you